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NASA TECH BRIEF

Structural Analysis and Matrix Interpretive System (SAMIS)

The problem:

The high-speed digital computer has been an increasingly popular tool for analysis of mechanical structures. Many programs have been generated to handle small-deflection behavior for specialized classes of structures such as trusses, frames, and shells of symmetric forms and loading. Lack of generalization and lack of flexibility limit the use of the programs and complicate data handling. Problem-size restrictions are becoming increasingly significant.

The solution:

A Structural Analysis and Matrix Interpretive System (SAMIS) that simplifies automated structural analysis and eliminates reprogramming for problem changes. These two objectives are, to some extent, in conflict. They are reconciled by choosing the following programming concepts: (1) whenever possible, standardize, (2) provide a modular program, and (3) program for intermediate-size problems.

How it's done:

Standardization is achieved in this program for output formats, most input formats, error handling, tape handling and formats, and storage assignment. Modularity is achieved by dividing the calculation into a number of tasks that can be performed in the sequence specified by the analyst. A single intelligence system is used. This approach facilitates adding or removing modules from the system. Programming for intermediate-size problems is achieved by providing for the use of tapes for data and program storage. To make this operation efficient, tape search is avoided where possible.

The SAMIS system consists of four components: The initiating link, the Master Intelligence, the operation links, and the input data. The initiating link (MAKER) generates the problem flow control data. Master Intelligence (MINTS) provides the link and data handling intelligence. MINTS subroutines control tape search, tape reading, matrix coding, and error operations. The operation links perform operations on arrays of data. Matrix sorting, addition, inversion, multiplication, and input and output handling are some examples of operations performed. Input data are required by the links to define the operations to be performed (pseudo instructions) and data for the particular problem under consideration. The pseudo instructions define data assignments, data tape assignments, matrix identification, and the sequence of link selection.

This program can handle matrices of intermediate size (500–10,000) efficiently as well as smaller sizes (less than 500) with a small penalty as compared to a specialized in-core routine. Whenever possible, problems are kept in-core to avoid the use of tape storage, which is inherently more time consuming. Answers are obtained in a single pass on the machine. Emphasis has been placed on self-checking, simple recovery from faults, and preservation of calculations up to the fault point. Application flexibility is attained by leaving operation sequence and data disposition under control of the analyst.

Notes:

1. Machine requirements are an IBM 7090/4 or 704X/709X computer with a minimum of thirteen available magnetic tape units.
2. One FAP subroutine and 98 percent FORTRAN II were used to program SAMIS.

(continued overleaf)

3. The unique matrix manipulative capability of this system would be of interest to the general users of high-speed digital computers.
4. Inquiries concerning this system may be directed to:

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Reference: B67-10171

Patent status:

No patent action is contemplated by NASA.

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